

WHAT IS CLAIMED IS:

1 1. An apparatus for enhancing image quality of a previously
2 coded digital video signal in a digital video system, said
3 apparatus comprising:

4 a usefulness metric generator within said digital video system
5 capable of generating a usefulness metric to determine an amount of
6 video enhancement that can be applied to said previously coded
7 digital video signal without enhancing coding artifacts.

1 2. The apparatus as claimed in Claim 1 wherein said digital
2 video system comprises at least one sharpness enhancement unit that
3 is capable of applying a sharpness enhancement algorithm to said
4 previously coded digital video signal, and wherein said apparatus
5 further comprises:

6 a coding gain control block capable of using said usefulness
7 metric to determine an allowable amount of sharpness enhancement
8 applied to said previously coded digital video signal by said at
9 least one sharpness enhancement unit.

1 3. The apparatus as claimed in Claim 2 wherein said at least
2 one sharpness enhancement unit is an adaptive peaking unit.

1 4. The apparatus as claimed in Claim 3 wherein said
2 usefulness metric calculates on a pixel by pixel basis how much a
3 pixel can be enhanced without increasing coding artifacts.

1 5. The apparatus as claimed in Claim 4 wherein coding gain
2 of a pixel is determined by the equation:

$$g_{\text{coding}}(i,j) = \text{UME}(i,j) + g_{\text{edge}}(i,j)$$

3 and wherein i and j are pixel coordinates, g_{coding} is a pixel
4 coding gain, UME is a usefulness metric, and g_{edge} is based upon
5 edge related information derived from an image.
6

1 6. The apparatus as claimed in Claim 5 wherein a value for
2 $g_{\text{edge}}(i,j)$ is calculated by setting the value of $g_{\text{edge}}(i,j)$ equal
3 to (1) an experimentally determined value c for an edge pixel
4 $p(i,j)$ at a spatial location (i,j) , and to (2) a value of one
5 half of c for a pixel $p(i-1,j)$ at a spatial location $(i-1,j)$
6 and for a pixel $p(i+1,j)$ at a spatial location $(i+1,j)$, and
7 to (3) a value of one fourth of c for a pixel $p(i-2,j)$ at a
8 spatial location $(i-2,j)$ and for a pixel $p(i+2,j)$ at a
9 spatial location $(i+2,j)$, and to (4) a value of zero for all
10 other pixels.

1 7. The apparatus as claimed in Claim 1 wherein said
2 usefulness metric generator utilizes only coding information to
3 generate said usefulness metric.

1 8 , The apparatus as claimed in Claim 1 wherein said
2 usefulness metric generator utilizes coding information and scene
3 content related information to generate said usefulness metric.

1 9. A digital video system comprising an apparatus for
2 enhancing image quality of a previously coded digital video signal
3 in said digital video system, said apparatus comprising:

4 a usefulness metric generator within said digital video system
5 capable of generating a usefulness metric to determine an amount of
6 video image enhancement that can be applied to said previously
7 coded digital video signal without enhancing coding artifacts.

1 10. The digital video system as claimed in Claim 9 wherein
2 said digital video system comprises at least one sharpness
3 enhancement unit that is capable of applying a sharpness
4 enhancement algorithm to said previously coded digital video
5 signal, and wherein said apparatus further comprises:

6 a coding gain control block capable of using said usefulness
7 metric to determine an allowable amount of sharpness enhancement
8 applied to said previously coded digital video signal by said at
9 least one sharpness enhancement unit.

1 11. The digital video system as claimed in Claim 10 wherein
2 said at least one sharpness enhancement unit is an adaptive peaking
3 unit.

1 12. The digital video system as claimed in Claim 11 wherein
2 said usefulness metric calculates on a pixel by pixel basis how
3 much a pixel can be enhanced without increasing coding artifacts.

1 13. The digital video system as claimed in claim 12 wherein
2 coding gain of a pixel is determined by the equation:

$$3 \quad g_{\text{coding}}(i,j) = \text{UME}(i,j) + g_{\text{edge}}(i,j)$$

4 and wherein i and j are pixel coordinates, g_{coding} is a pixel
5 coding gain, UME is a usefulness metric, and g_{edge} is based upon
6 edge related information derived from an image.

1 14. The digital video system as claimed in Claim 13 wherein a
2 value for $g_{\text{edge}}(i,j)$ is calculated by setting the value of g_{edge}
3 (i,j) equal to (1) an experimentally determined value c for an edge
4 pixel $p(i,j)$ at a spatial location (i,j) , and to (2) a value of
5 one half of c for a pixel $p(i-1,j)$ at a spatial location $(i-1,$
6 $j)$ and for a pixel $p(i+1,j)$ at a spatial location $(i+1,j)$,
7 and to (3) a value of one fourth of c for a pixel $p(i-2,j)$ at a
8 spatial location $(i-2,j)$ and for a pixel $p(i+2,j)$ at a
9 spatial location $(i+2,j)$, and to (4) a value of zero for all
10 other pixels.

1 15. The digital video system as claimed in Claim 9 wherein
2 said usefulness metric generator utilizes only coding information
3 to generate said usefulness metric.

1 16. The digital video system as claimed in Claim 9 wherein
2 said usefulness metric generator utilizes coding information and
3 scene content related information to generate said usefulness
4 metric.

1 17. A method for enhancing image quality of a previously
2 coded digital video signal in a digital video system, said method
3 comprising the steps of:

4 generating a usefulness metric in a usefulness metric
5 generator in said digital video system; and

6 utilizing said usefulness metric to determine an amount of
7 video image enhancement that can be applied to said previously
8 coded digital video signal without enhancing artifacts.

1 18. The method as claimed in Claim 17 wherein said digital
2 video system comprises at least one sharpness enhancement unit that
3 is capable of applying a sharpness enhancement algorithm to said
4 previously coded digital video signal, and wherein said method
5 further comprises the step of:

6 utilizing said usefulness metric in a coding gain control
7 block to determine an allowable amount of sharpness enhancement
8 applied to said previously coded digital video signal by said at
9 least one sharpness enhancement unit.

1 19. The method as claimed in Claim 18 wherein said at least
2 one sharpness enhancement unit is an adaptive peaking unit.

1 20. The method as claimed in Claim 19 wherein said usefulness
2 metric calculates on a pixel by pixel basis how much a pixel can be
3 enhanced without increasing coding artifacts.

1 21. The method as claimed in Claim 20 wherein coding gain of
2 a pixel is determined by the equation:

$$g_{\text{coding}}(i,j) = \text{UME}(i,j) + g_{\text{edge}}(i,j)$$

3 and wherein i and j are pixel coordinates, g_{coding} is a pixel
4 coding gain, UME is a usefulness metric, and g_{edge} is based upon
5 edge related information derived from an image.
6

1 22. The method as claimed in Claim 21 wherein a value for
2 $g_{\text{edge}}(i,j)$ is calculated by setting the value of $g_{\text{edge}}(i,j)$ equal
3 to (1) an experimentally determined value c for an edge pixel
4 $p(i,j)$ at a spatial location (i,j) , and to (2) a value of one
5 half of c for a pixel $p(i-1,j)$ at a spatial location $(i-1,j)$
6 and for a pixel $p(i+1,j)$ at a spatial location $(i+1,j)$, and
7 to (3) a value of one fourth of c for a pixel $p(i-2,j)$ at a
8 spatial location $(i-2,j)$ and for a pixel $p(i+2,j)$ at a
9 spatial location $(i+2,j)$, and to (4) a value of zero for all
10 other pixels.

1 23. The method as claimed in Claim 17 comprising the step of:
2 utilizing only coding information to generate said usefulness
3 metric in said usefulness metric generator.

1 24. The method as claimed in Claim 17 comprising the step of:
2 utilizing coding information and scene content related
3 information to generate said usefulness metric in said usefulness
4 metric generator.